DIRECTIONS

77-6-0-5

2284-a, b, c AND d
GALVANOMETERS

LEEDS & NORTHRUP

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DIRECTIONS FOR
NO. 2284-a, b, c AND d
GALVANOMETERS

1. GENERAL DATA

The No. 2284 Galvanometer is a high sensitivity instrument for use in work of the highest precision. The instrument should be handled carefully during unpacking and a check should be made against the shipping list to be certain that no parts are discarded with the packing material.

The No. 2284 Galvanometer is shipped with a complete system mounted, and with the coil clamped, in the case. There is also an envelope containing a plano-convex lens having a one meter focal length. Standard instruments containing copper suspensions are also supplied with an extra suspension in a small glass tube. Directions for removing these suspensions from the tube are supplied on the envelope containing the tube. The knurled knob A, Fig. 1, fits loosely on the COIL CLAMP rod or the ZERO ADJUSTER rod and may become displaced in shipping or handling the galvanometer. Make certain this knob is not discarded in the packing material.

The No. 2284 Galvanometer is equipped with copper connecting strips from the binding posts T, Fig. 1, to the galvanometer system terminals and is also equipped with copper suspensions, in order to lessen internal thermal electromotive forces.

It is very important that the case of the instrument be removed only when absolutely necessary, and then only with clean hands and in a room as free as possible from dust and dirt.

Under the front edge of the moulded base is a small white plate, pivoted at the left side. On this plate are listed the characteristics of the galvanometer.

2. SETTING UP AND LEVELING (Fig. 1)

To obtain the characteristics specified for this galvanometer it is necessary to make certain that the coil is in the proper position in the field. This position can be adjusted by means of the leveling screws.

When shipped from the factory, the three leveling screws B are turned up tight and can be turned only in a clockwise direction, viewing the galvanometer from the top. Turn each of the screws B out three or four turns. This permits subsequent adjustment of any leveling screw either in or out. Turning any one of these screws in a clockwise direc-

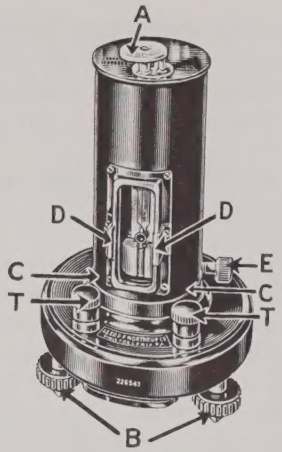

Fig. 1

tion, when viewed from above, will cause the coil to move in a direct line away from the screw, and vice versa.

Place the galvanometer in the position in which it is to be used. The mounting table, bracket or pedestal should be free from vibration and as nearly level as possible. Place the knurled knob A on the COIL CLAMP rod, and turn it in a counterclockwise direction as far as it will turn. This releases the coil, allowing it to swing on the upper suspension. Then adjust the leveling screws B until the galvanometer coil swings centrally between the pole faces and does not strike the pole faces or the core during a full deflection to either side.

After the galvanometer coil is swinging freely, as directed in the preceding paragraph, it may be necessary to make very slight adjustments of one or more of the leveling screws B, Fig. 1, in order to obtain the desired characteristics. For instance, higher sensitivity may be obtained by adjusting the leveling screws to move the galvanometer coil slightly forward or backward in the field.

3. ZERO ADJUSTMENT (Fig. 1)

Place the knurled knob A on the ZERO ADJUSTER rod. Turning this knob in a clockwise direction, when viewed from above, will cause the coil to turn in a clockwise direction, when viewed from above, and vice versa. Knurled knob E is a micrometer adjustment for the same purpose. Turning this knob in a clockwise direction will cause the coil to turn in a clockwise direction when viewed from above, and vice versa.

4. ZERO SHIFT

The zero shift of a galvanometer is the angular difference between the original zero position and the subsequent zero position after a de-

flection. This angle is usually expressed in millimeters (length of chord or arc subtended by the angle of shift at a distance of one meter from the galvanometer). The amount of zero shift depends upon the magnitude of the deflection and upon the sensitivity of the galvanometer.

It is impossible to avoid zero shift in the No. 2284 Galvanometers owing to their high sensitivity.

When the galvanometer is used with the null method of reading there is no necessity for taking the zero shift into consideration in the readings if the galvanometer circuit is opened momentarily to determine whether current is flowing through the galvanometer. If the galvanometer does not move when opening or closing its circuit the galvanometer is balanced and the reading can be taken without giving consideration to the zero shift.

In using a No. 2284 Galvanometer (or any galvanometer having zero shift) with the deflection method of reading, where a continuous set of deflections and readings will be to the same side of zero, the effect of zero shift in the galvanometer may be eliminated or materially reduced by the following procedure: Have the galvanometer critically damped. That is, use sufficient external resistance in series with the galvanometer coil or shunted across the coil so that when the galvanometer is deflected and the current is cut off, the galvanometer will come to rest in the minimum time without oscillating. It is recommended that the resistance added for damping purposes be in the form of fixed coils rather than adjustable resistance boxes as it is possible that thermal electromotive forces may occur in the adjustable resistance boxes and cause an error in galvanometer operation. After proper damping is established, deflect the galvanometer to the side of zero on which the set of readings is to be taken. Allow the galvanometer to return toward zero and come to rest. Note the new zero point. Move the scale so that the scale zero matches the new galvanometer zero. Repeat this procedure at least three times. After the fourth deflection the scale should not have to be changed as the galvanometer should then return to the same zero point, thus establishing a stable zero.

After the new stable zero has been established the set of readings can be made, with accuracies within the characteristics of the galvanometer being used, as long as the continuous set of readings are on the same side of zero as stated above.

The stability of the zero will be improved by not clamping the galvanometer coil except when the galvanometer is moved from one location to another.

5. TO REMOVE CASE (Fig. 1)

Place knurled knob A on COIL CLAMP rod and turn in a clockwise di-

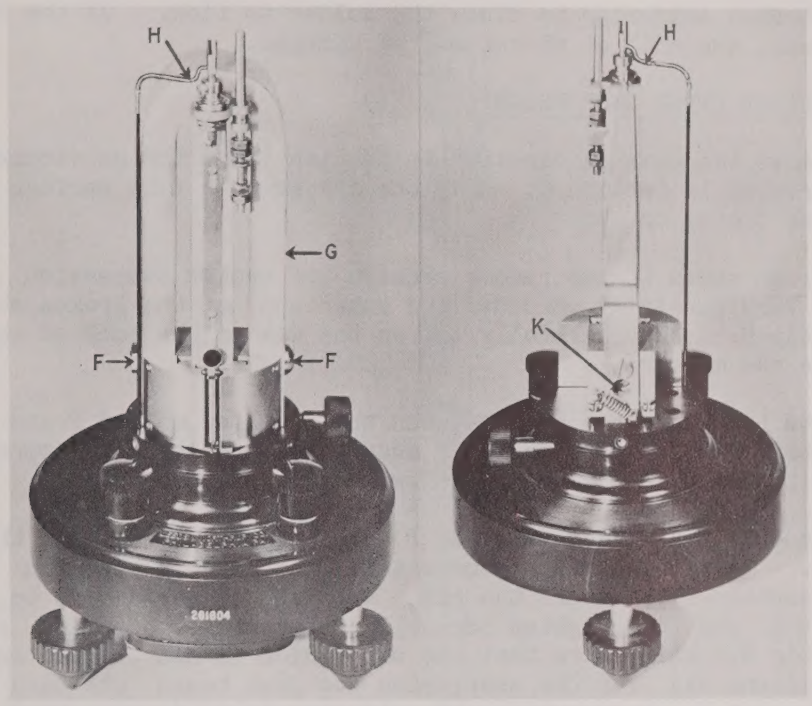

Fig. 2

rection as far as it will go. This will clamp the coil and take the tension from the upper suspension. Remove the three screws C and the knurled knob A. Then carefully pull the case up and off, exposing the galvanometer as in Fig. 2.

6. TO REMOVE GALVANOMETER SYSTEM (Fig. 2)

Remove the case as directed in Section 5. Remove the nut and bolt F and lift off the magnet G with the least amount of sliding motion. Unsolder the flexible connection at H and remove screw K. The galvanometer system, including the support and pole pieces, can now be lifted up and out of the base. In lifting, hold the pole pieces and be careful not to break the suspensions.

7. SOLDERING

When replacing suspensions, where it is necessary to solder connections, avoid using a soldering flux which has a corrosive action. Rosin dissolved in alcohol to the consistency of a thick paste is recommended for this purpose.

Use a very small soldering iron (copper tip) and use only suffi-

cient heat when soldering to cause the solder to flow. If the heat used is too great, the coil or mirror may be damaged.

8. TO REPLACE UPPER SUSPENSION (Fig. 3)

Remove the case as directed in Section 5 and the galvanometer system as directed in Section 6. Lay the system on a flat surface with the suspensions facing up.

Loosen screw L and remove section of broken suspension from the socket. Very carefully unsolder the other end of the broken suspension from the tip M. Also carefully soften the wax on the back of the mirror and remove the mirror.

Note the clearance at N between the shoulder on rod P and the collar (containing screw R) as rod P must be brought back to approximately this same position in making the adjustments as directed below.

Loosen screw R and push rod P down approximately half the clearance at N. Using tweezers, remove the replacement suspension from its shipping container. Insert the tip, with the soldered side up, in the socket at L and then tighten screw L. Place the suspension along the front of tip M, being sure that the suspension is not twisted and allowing sufficient sag for the suspension to just touch the back support. Solder at point M, by drawing the soldering iron (copper tip) along M toward the mirror. Cut off the surplus portion of the suspension at the point M.

Replace the mirror. It must very carefully be centered on its support and sealed in place with bee's wax after the new suspension is in place. Do not use a commercial wax for this purpose as it may warp the mirror.

Lower the system into place in the base and secure it with screw K, Fig. 2. Put the magnet in place (beveled edge to the rear), and replace bolt and nut F, Fig. 2, while holding the magnet as near the pole pieces as possible. Solder flexible connection at H, Fig. 2. Place the knurled knob A, Fig. 1, on the COIL CLAMP rod and release the coil. Loosen screw R, Fig. 3, and carefully raise the ZERO ADJUSTER rod P until the coil hangs free of the center core with the bottom of the coil approximately half way between the end of the short guide pin (on the bottom of the core) and the bottom of the core. Tighten screw R, and level the galvanometer with screws B, Fig. 1, until the top of the coil is central over the core. Examine the coil to see that it clears the core an equal amount on each side and that the plane of the coil is parallel to the center line of the core. If the coil does not hang properly, clamp the coil and bend the tip M, Fig. 3, at the point at which it joins the coil. The bottom of the coil will move in the same direction that the tip M is bent; that is, if the tip M is bent toward the front, the bottom

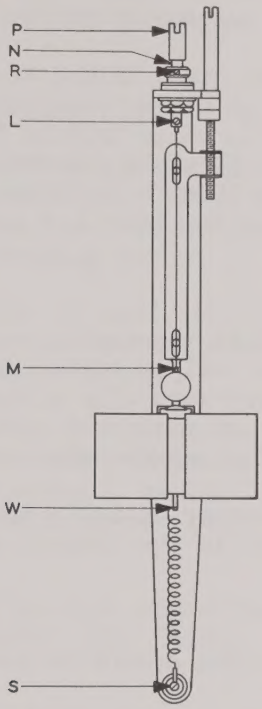

Fig. 3

of the coil will move toward the front, and vice versa, and if the tip M is bent toward the right, the bottom of the coil will move toward the right and vice versa. Test and repeat until the proper adjustment is obtained. Then clamp the coil and remove knurled knob A, Fig. 1, from the COIL CLAMP rod. Replace the galvanometer case and secure it with the three screws C, Fig. 1. Adjust the instrument as directed in Sections 2, 3 and 4.

9. TO REPLACE LOWER SUSPENSION (Fig. 3)

Remove the case as directed in Section 5 and the galvanometer system as directed in Section 6. Lay the system on a flat surface with the suspensions facing up.

Loosen screw S and remove the section of the broken suspension from the socket. Carefully unsolder the other section of the broken suspension from tip W. Remove the new suspension from the shipping container according to directions sent with the suspension and be sure not to lose any turns from or add any turns to the suspension. Insert one tip of the suspension, with the soldered side up, in the socket at S and tighten screw S. With tweezers and small soldering iron, remove the other end of the suspension from its tip, while the tip is still in the cork, and

solder this free end of the suspension to tip W on the galvanometer coil.

Lower the system into place in the base and secure it with screw K, Fig. 2. Put the magnet in place (beveled edge to the rear), and replace bolt and nut F, Fig. 2, while holding the magnet as near the pole pieces as possible. Solder flexible connection H, Fig. 2. Replace the galvanometer case and secure it with the three screws C, Fig. 1. Adjust the instrument as directed in Sections 2, 3 and 4.

10. TO REPLACE COIL

To replace a coil it is necessary to remove the pole pieces from the support. After the new coil is installed and the pole pieces put in place it is necessary to very carefully adjust the pole pieces (by means of the two adjusting screws in each pole piece) in order to obtain the proper characteristics for the galvanometer with the new coil.

This procedure is a rather delicate one and it is recommended that the galvanometer be returned to the factory when a new coil is required.

11. PRECAUTIONS

The following precautions should be carefully observed in handling the magnet:

1. Do not drop or handle roughly.

2. Do not place one magnet close to another.

3. When the magnet is removed from the case in order to replace a suspension, etc., the magnet should be fitted with a keeper.

4. When putting on or removing a keeper, do not slip it along the side of the magnet but put it directly on or pull it directly away from the ends of the poles.

5. When removing the galvanometer system from the instrument, follow the directions and always remove the magnet before removing the galvanometer system.

Do not turn the adjusting screws in the sides of the pole pieces, as in doing so the characteristics of the galvanometer may be changed.

12. ACCESSORY APPARATUS

Lamp and Scale, such as L&N No. 2100 or No. 2110; or
Telescope and Scale, such as L&N No. 2196; or
Wall Bracket with Telescope and Scale combination, such as L&N No. 2148; or

Wall and Table Bracket with Telescope and Scale combination, such as L&N No. 2149.

13. USE OF LAMP AND SCALE READING DEVICE

In an envelope attached to the galvanometer is a plano-convex lens having a focal length of one meter. When using the lamp and scale at a distance of one meter, place the lens in the lens holder D, Fig. 1, with the curved side toward the reading device.

If the lamp and scale is used at a distance of less than one meter, a one-half meter lens can be furnished. For distances greater than one meter, special lenses can be ground.

Only straight scales are furnished for use with the lamp and scale reading device. It is, therefore, advisable to use only the null method of reading this type of equipment as the deflection readings on the straight scale are not strictly proportional to the current and voltage in the galvanometer circuit.

The galvanometer may be used above the lamp and scale reading device by providing Wall Bracket (No. 2146), Prism (No. 2178) and Angle Mirror (No. 2104).

14. USE OF TELESCOPE AND SCALE READING DEVICE

Either a curved or straight scale type of telescope and reading device may be used where null type measurements are performed; that is, measurements, such as are made with a Wheatstone bridge or null potentiometer, in which the circuit is adjusted until the galvanometer is brought to its mechanical zero position at which time no current is flowing in the galvanometer circuit.

A curved scale type of telescope and reading device should be used for deflection type measurements with the scale at one-half meter distance from the galvanometer. With this arrangement the deflections will be proportional to the current and voltage in the galvanometer circuit.

The sensitivity of the galvanometer is based upon one meter distance between galvanometer and reading device. Corrections should be applied to the sensitivity given, when the distance between galvanometer and reading device is other than one meter.

Do not use a lens with the galvanometer when a telescope and scale is used as a reading device.

---CAUTION---

CLAMP THE GALVANOMETER COIL BEFORE MOVING THE GALVANOMETER

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